J. Bruce Gemmell

Ore Shoot Targeting in the Gosowong Vein Zone, Halmahera, Indonesia.

by
Daniel J. Olberg, B.Sc.

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ABSTRACT

Gosowong is located in the Maluku province of eastern Indonesia, on the north arm of the island of Halmahera. It is a classic example of a volcanic-hosted, low-sulfidation, epithermal quartz vein Au deposit. Due to the relatively short mine life, there is a very limited time frame for increasing ore reserves before mining ceases. Therefore a great emphasis has been placed on exploring the strike extent of the structure that hosts the Gosowong deposit. This mineralized structure is known as the Gosowong Vein Zone (GVZ) and has been traced along strike for 2 km, though the Gosowong deposit encompasses only a 400 m section of the total strike length. The primary aim of this study is to identify additional high-grade ore-shoots along the GVZ. To this end, a multi-faceted approach has been implemented incorporating structure, stratigraphy, vein textures, alteration zoning, fluid inclusions, and metal ~~zoning~~ zonation, with the ultimate aim being to construct a system model that will allow predictive targeting of high-grade ore-shoots along the GVZ. Most data are presented on a longitudinal section of the GVZ.

High-grade mineralization at the Gosowong deposit occurs within two gently south-plunging ore shoots: the Quartz-Adularia zone (QA) and the Quartz-Chlorite zone (QC). The interplay between structure and stratigraphy is thought to be one of the main controls on the emplacement and distribution of high-grade mineralization at Gosowong. A distinct mappable volcanic stratigraphy has been recognized within generally intermediate to mafic coherent volcanic and volcaniclastic rocks of Miocene age. The preferential host rocks to faulting and subsequent quartz veining are the Gosowong Volcaniclastics, a package of resedimented volcaniclastic rocks with interbedded ignimbrite and andesitic lava. This unit dips moderately to the south, striking roughly perpendicular to the strike of the GVZ. The intersection between the volcaniclastic stratigraphy and the Gosowong fault (GVZ 2) is thought to be the key factor in the deposition of high-grade mineralization. (= GVZ = Gosowong fault?)

A study of quartz vein textures along the GVZ has shown that high-grade mineralization is generally developed in discrete shoots within lower grade or barren mineralization. The vein texture most commonly associated with high-grade mineralization is poly-compositional crustiform/colloform/cockade banding. The presence of bladed calcite pseudomorphs at various levels in the system is a positive indication of boiling, though they do not always carry significant Au grades. Banded chalcedony and phreatic breccia deep in the system perhaps indicates further potential at depth. (ECONOMIC)

Alteration zoning was mapped out with the use of a PIMA mineral analyzer. The alteration in the GVZ is typical of low-sulfidation, epithermal deposits. Illite-group minerals are

dominant in the ore horizons while propylitic assemblages are usually associated with weakly mineralized veining. Illite-group minerals and chlorite display a distinct zoning along the fluid flow pathway, from illite-chlorite $\Rightarrow$ illite $\Rightarrow$ illite-smectite $\Rightarrow$ smectite-illite with decreasing depth. Alteration zoning mimics stratigraphy, as indicated by gently south plunging paleo-isotherms. Mineralizing fluids are postulated to have ascended the Gosowong fault and then spread out laterally along the permeable volcaniclastic horizon.

Fluid inclusion analyses indicate that mineralizing fluids have a typical epithermal signature: dilute (generally <1.0 eq. wt. % NaCl) and low temperature (generally 175-265°C). Coexisting vapor-rich and liquid-rich primary fluid inclusions indicate that boiling processes have taken place in the GVZ. Trapping temperatures in the QA zone suggest that quartz deposition took place 100-350 m below the paleo-water table. The variation in trapping temperatures between the QA (210°C) and the QC (236°C) may indicate multiple mineralizing events. Paleo-isotherms mimic the stratigraphy, plunging gently to the south, indicating a component of horizontal fluid flow through the permeable volcaniclastic units.

The GVZ appears to display most of the typical vertical metal zoning common in low-sulfidation epithermal systems: base metals dominant deep in the system, precious metals dominant at shallow levels. Base metal values are generally ~~very~~ low, averaging 125 ppm Cu, 53 ppm Pb, and 83 ppm Zn. Lead is the base metal most closely associated with Au mineralization. The distribution of high Au and Ag values indicates a gentle southerly plunge to the precious metal-rich horizon. Increasing Cu/Zn, Zn/Pb, and precious-metal/base-metal ratios may indicate vectors to ore-grade mineralization.

It appears that the southerly plunge of the strata, ore-shoots, paleo-isotherms, alteration zoning, and metal zoning may be in part due to the post-mineral tilting of the GVZ. It is believed that pre-mineralization deformation has rotated the strata approximately 25-30° to the south, while post-mineralization deformation has added an additional 10-15° to the overall rotation of the strata. Thus, deeper levels of the system are exposed closer to the surface on the north end of the GVZ.

A Gosowong specific "prospectivity matrix" has been constructed based on the sum total of the relative prospectivities of each of the components analyzed in this study. This matrix indicates that the most prospective area of the GVZ (outside of the Gosowong deposit area) is the area deep and to the south of the deposit. Additional, slightly less prospective areas have been delineated and a total of 5 drill holes have been targeted on these zones of interest.

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